Advanced Cap Sensing for Water-Tolerant Touch & Digital Level Sensing

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

Presented by

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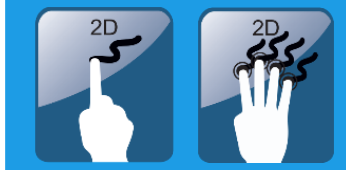
April 28, 2026

A Leading Provider of Touch Technology

User interface

Sensors

Buttons, Sliders and Wheels, Proximity



Touchpads and multi-touch screens

Free space Gesture Recognition

Capacitive Sensing of Digital Liquid Level & Water Tolerance

MICROCHIP

Microchip Touch

	Turnkey Devices	Touch Microcontroller + Library
	NEW **MTCH2120** • I²C, 1-12 keys and proximity • Highest EMI robustness • Water tolerant, fully flexible **MTCH10xx** • GPIO, 1-8 keys / proximity • Mech button replacement **AT42QTxxxx** • 1-64 keys, sliders / prox • I²C / SPI / GPIO • EN 60730 Class B Safety **CAP11xx/CAP12xx** • 3-14 keys, sliders / prox • LED, I²C interface	**PIC®/ AVR® / dsPIC33 / SAM / PIC32** • MCUs with hardware touch controller • High-Speed ADC Enabled Touch DSCs • Touch library for keys, sliders and proximity
	**maXTouch®** • Multi-touch touchscreen and trackpad controller	**PIC / AVR / dsPIC33 / SAM / PIC32** • MCUs with hardware touch controller • High-Speed ADC Enabled Touch ADCs • Touch library for dual touch 2D touchscreen and trackpads
	**GestIC®** • 3D gesturing controller	
Sensing Solutions		**Liquid Digital Level Sensing** **ITS (Impulse Touch Sensing)** • Water Tolerance Capacitive Sensing

Time for Touch, Microchip Touch

- **Touch is replacing mechanical buttons**
  - Easy design
  - Low cost – standard MCU peripheral
  - Water and EMI robust
- **Better look, feel and end user experience**
  - Buttons, sliders, wheels
- **Capacitive Sensors**
  - Level sensing

Microchip: The world's preferred touch supplier

MICROCHIP

Long-term Innovative Player in Touch

Microchip serves **all Markets and all use cases** for touch

Consumer | **Appliances** | **Medical** | **Industrial** | **Automotive** | **Wearables** | **IoT** | **Avionic**

Technologies

- Automatic Sensitivity adaption
- Boost Mode
- Adaptive noise avoidance
- Water tolerant touch buttons
- Water tolerant touch pads/screens
- Touch HW solutions on MCU
- Driven shield - multiple
- Feeding line compensation
- Low power sensor lump
- Mutual
- Self

2024 Capacitive Level Sensing

2023 ITS Impulse Touch Sensing

2022 Functional Safety Touch Library, SEooC

2021 Multi-Touchpads on MCU

2021 Hands off Detection

2021 Graphics + Touch – single MCU Touchscreens

2019 Boost Mode Touch

2018 2D Touch surface library for MCUs

2017 MCC/START raise the bar for touch design tools.

2016 Microchip acquires Atmel

2014 2D Touchpads on MCU

2013 Water tolerant touch / Driven Shield+

2012 Microchip/Atmel launch MCU with touch hardware : HCVD / PTC

2012 Touch on metal - MoC

2008 Atmel acquires Quantum.

2007 Microchip establish Touch BU.

1999 Quantum Research Group commercializes Touch utilizing Microchip MCU

Use cases

- Level sensing
- 3D Gestures
- Grip sensing
- Hands on detection
- Gloves support without hover-touch
- Touchscreen
- Touchpad
- High button count
- Proximity
- Wheels
- Sliders
- Buttons

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Microchip's Touch Markets

20 years of global experience

Microchip Touch in Automotive

outside

inside

Steering Wheel

Hands Off Detection

Door Handle/Buttons

HVAC

EV Charge Flap

Sunroof/Interior Lighting

Mirror Control

Center Stack

Seat Adjustment

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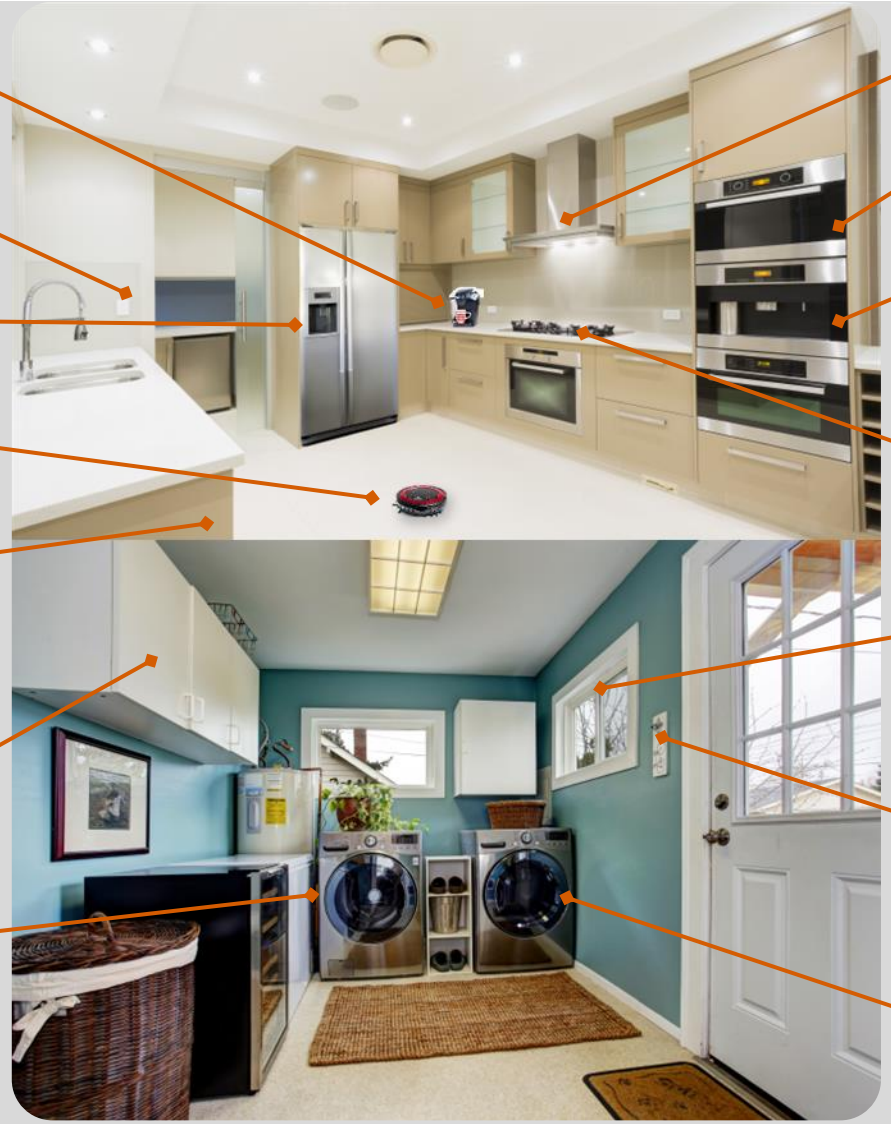
Microchip Touch in Your Home

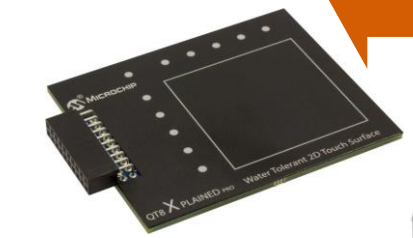


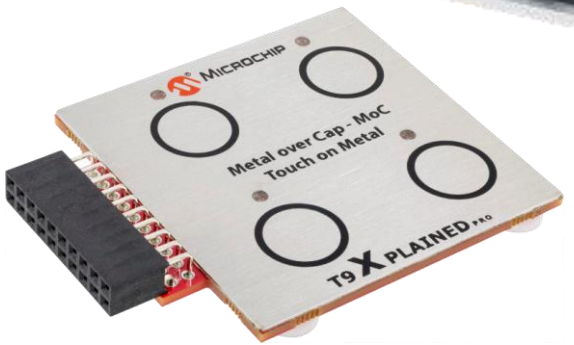
Why Microchip is #1

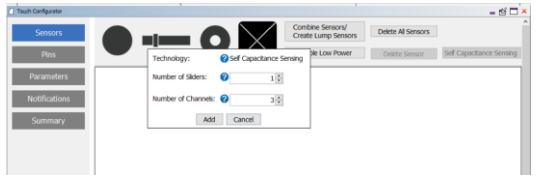
- **Most innovative touch solution**
- **Superior water and EMI robustness**
  - Advanced shielding and signal processing techniques
- **Ultra-low power operation**
- **Best-in-Class development tools**
  - Design touch from scratch in a few hours
- **Most complete solution**
  - Widest range of touch MCUs
  - Touch turnkey solution
- **Best global support**
  - Local support of design AND manufacturing
  - Local support in local language

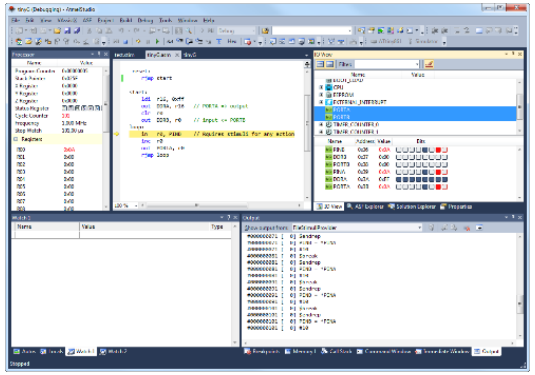
It’s Easy to Get Started

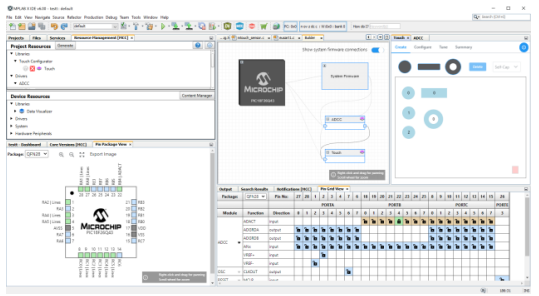
Seamless transition across PIC®/AVR®/SAM MCUs and dsPIC33C DSCs with the same Touch ecosystem

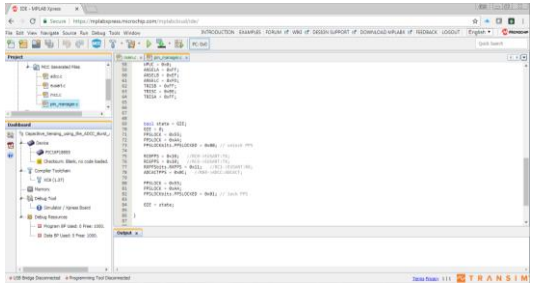










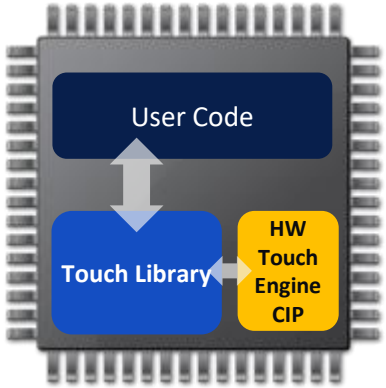


MPLAB DISCOVER | MPLAB X IDE | MPLAB CODE CONFIGURATOR | MPLAB DATA VISUALIZER

Get a touch DevKit → **Install Development Tools** → **Run the Code Configurator** → **Integrate touch!**

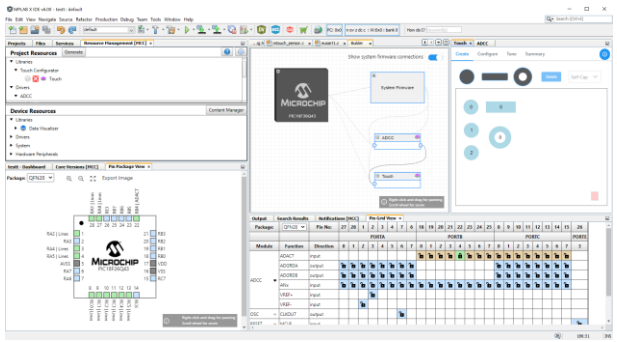
Link to Touch DevKits | Link to MPLAB® X | Link to MCC | Link to MPLAB Data Visualizer

Ease of Use Integrating Touch



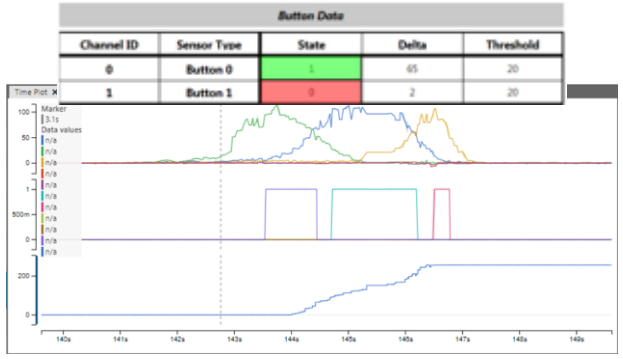
On-Chip Touch Controller

- Full integration
- Superior code integration



Easy Code Configuration GUI

- Graphical configuration wizard
- Automatic code generation
- MPLAB® Code Configurator / Harmony 3 / START



Graphical Touch Tuning Tool

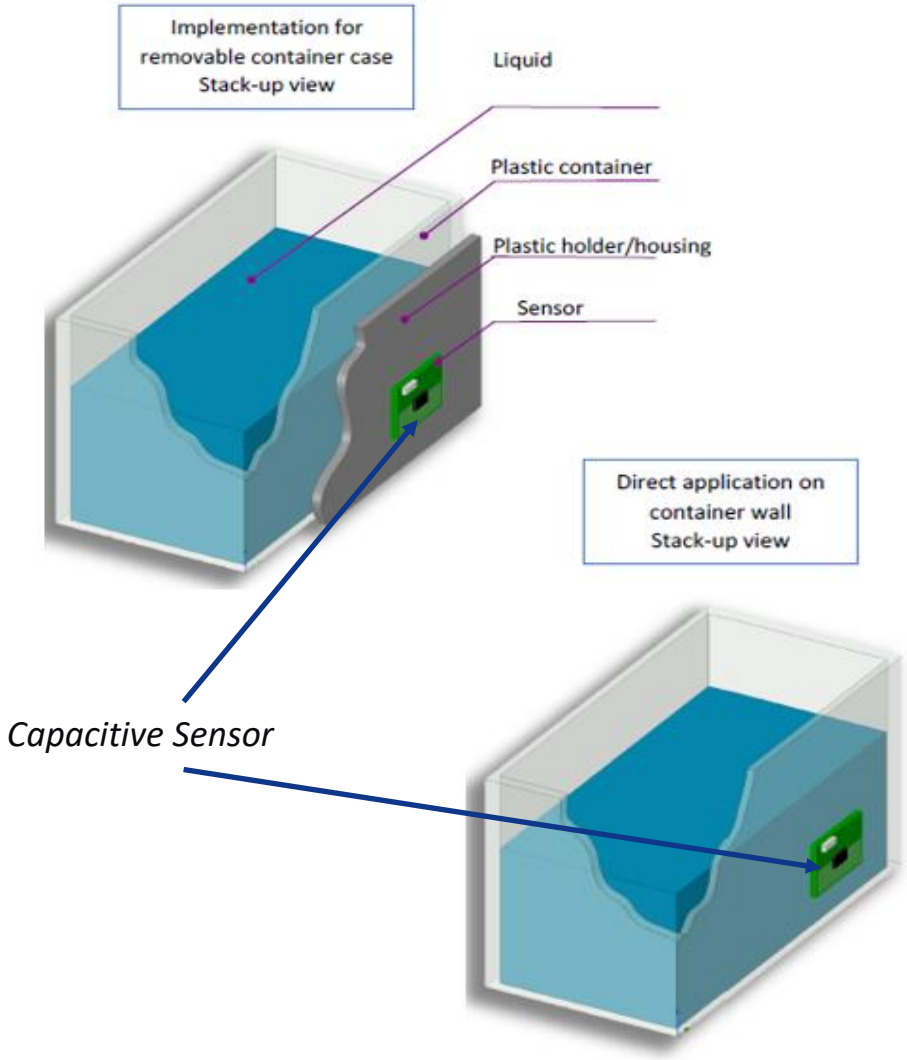
- Real-time touch data
- Easy & guided touch application tuning

Digital Level Sensing (DLS) Solution

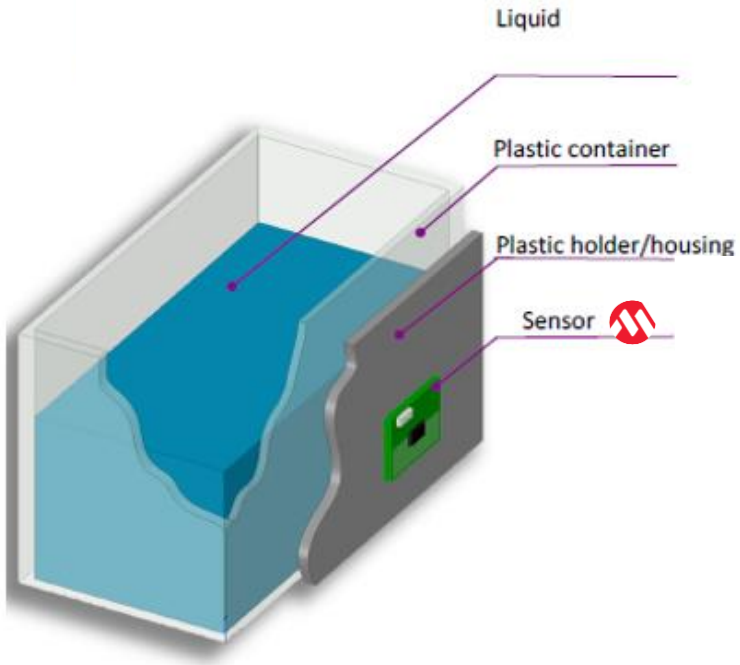
Capacitive Liquid Level Sensing

Introduction

- **Principle**
  - Capacitive sensing electrodes connected to a MCU doing the data acquisition, filtering and report status to a host
- **Capacitive sensing is**
  - Non-invasive
  - Not in contact with the liquid (no corrosion effect or deposit on the electrode)
  - Durable with no moving mechanical parts
  - Robust solution
- **Capacitive sensing give greater design flexibility**
  - Sensor can be designed to adapt to various surface shapes and dimension
  - On the container self or in close proximity for removable container



Advantages of Microchip Solution

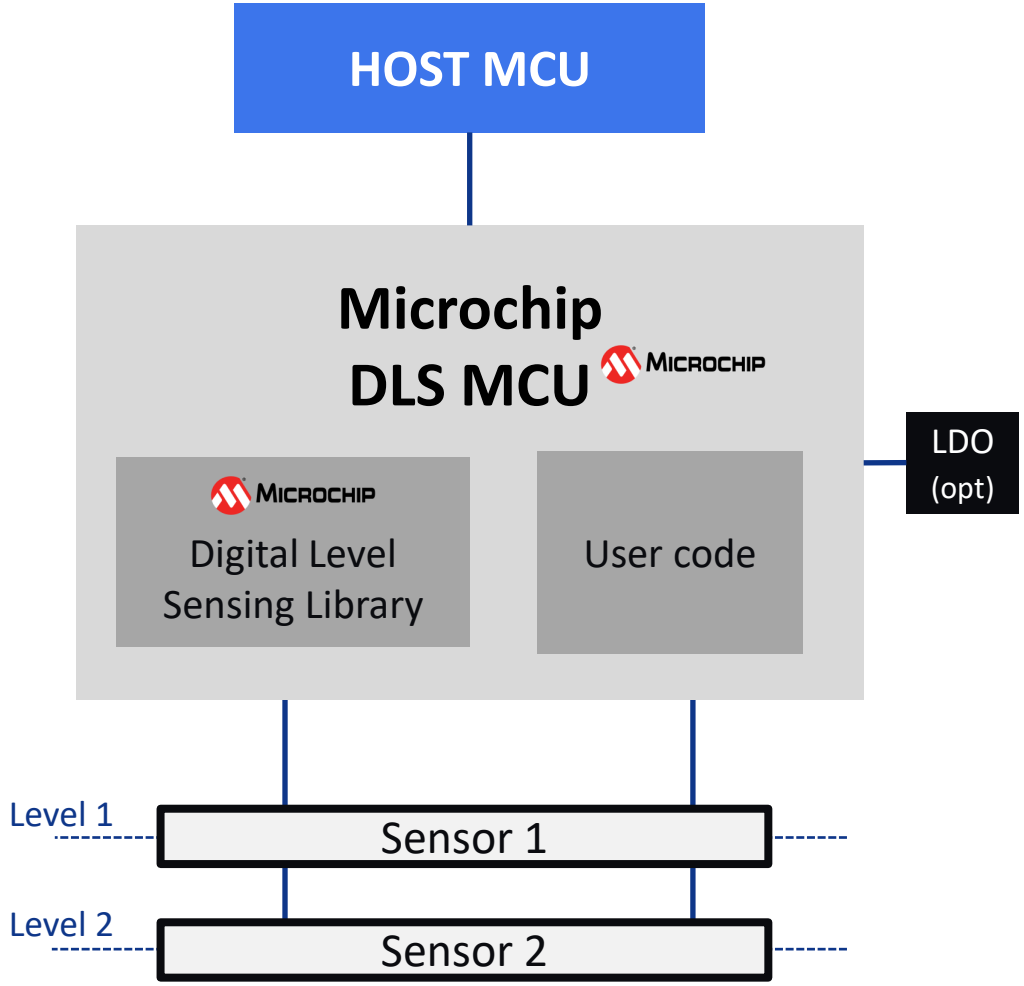


- Unique Ground independence technology
- Robust to noise and environmental changes
- Ready to implement solution package
- Directly on a container or at a short distance

Microchip Digital Level Sensing (DLS)

Overview of the solution

- **On/off Digital Switch**
  - Reporting when a threshold is reached to a host
  - Up to 2 levels detection by default
  - Immune to any grounding effects (unique!), Robust to noise
  - Always correct at power up – system works without calibration
- **Complete solution:**
  - No coding require, no experience in touch needed
  - Freedom to integrate in your application
- **You simply buy a DLS enabled MCU(1). Done.**
- **We provide the pre-compiled level sensing library + example application code(2)**



(1) HoD enabled MCUs are not –pre-programmed. Your tailored solution will run.

(2) NDA required

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What Can We Detect?

DLS – Digital Level Sensing

- **Primary target is water**
  - The DLS solution is fully validated with water
  - Other liquids can work too
    - Sensitivity will be different; deposit on the container surface will affect the reading
      → Validation recommended
- **Can I sense solid materials?**
  - Yes, that's possible(!)
  - Examples:
    - wood pellets, coffee beans, …
      → validation recommended



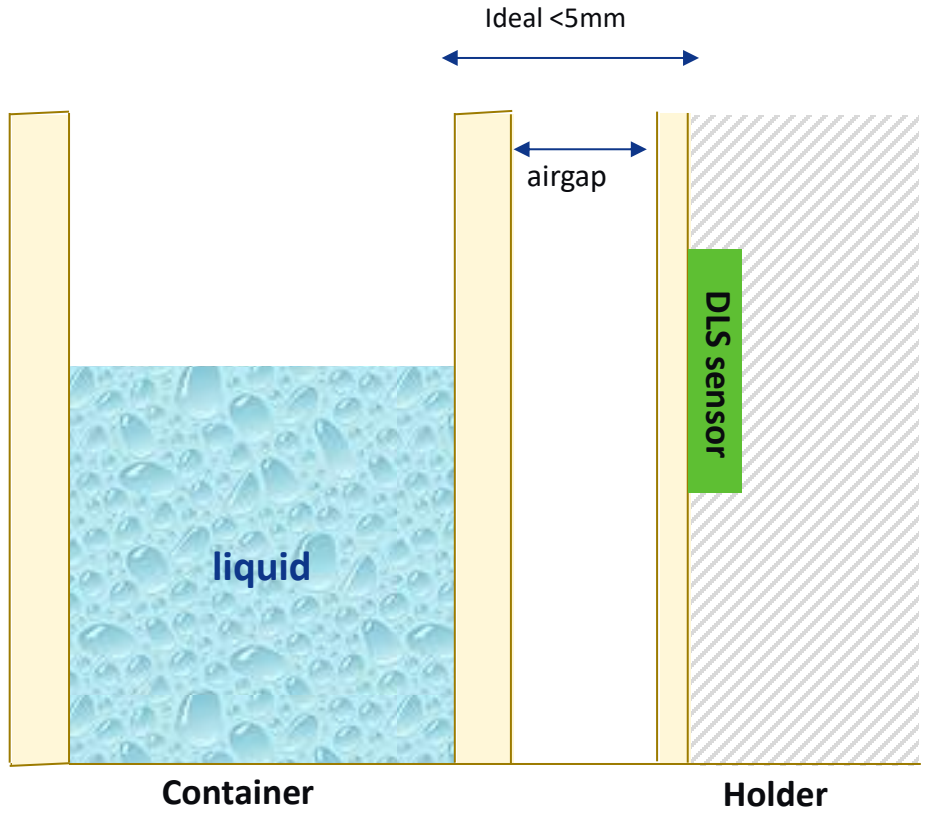


Important Considerations

Before starting a project

- **Mechanical design**
  - Mechanical stack-up plays an important role in the robustness and sensitivity
  - Thickness and material of the container
  - Air gap between the sensor and the liquid
  - How stable the air gap is
- **Electrode design**
  - Electrode shape and area will give different sensitivity
- **Environmental conditions can affect the reading**
  - Temperature changes, humidity
  - Deposit on the surface
  - Ground coupling interferences with the electrodes

Microchip hardware design review service will ensure your success



Best performance with total stack-up (incl air gap) < 5 mm

Robust and Innovative Solution

Immune to grounding effects

Why does grounding change?

- **In level sensing grounding may change any moment due to:**
  - User touches the tank of coffee machine
  - User put finger in the liquid
  - Liquid grounded while pouring - becoming non-grounded the moment the pouring ends
  - Grounding changes by electronics / components while regular usage (wires, rotators, motors, …)

Why is that relevant?

- **Grounding conditions do influence capacitive sensors in general**
- **In level sensing, the reported level might change due to grounding changes**
- **Using regular capacitive sensing for liquid level sensing won't mitigate this effect – all changes will be visible in the signal(!)**

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Microchip Level sensing technology enables **ground condition independent level reporting**
Increased accuracy, reliability, and ease of use

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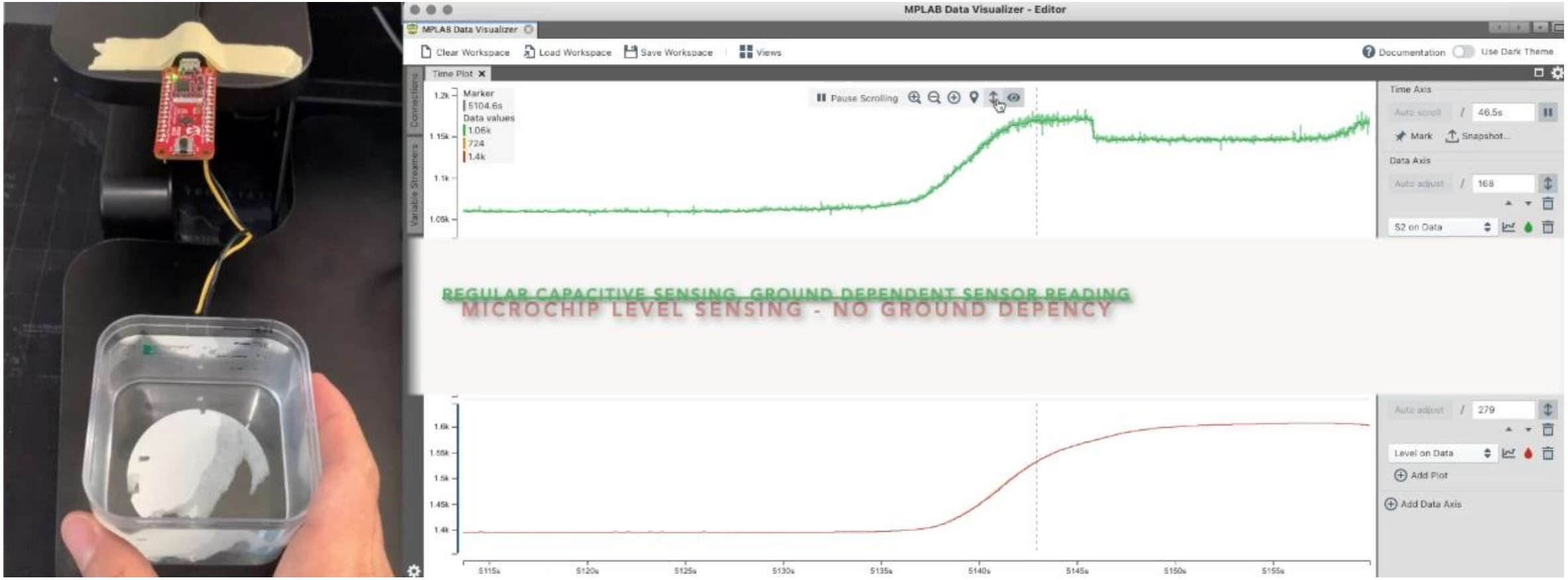
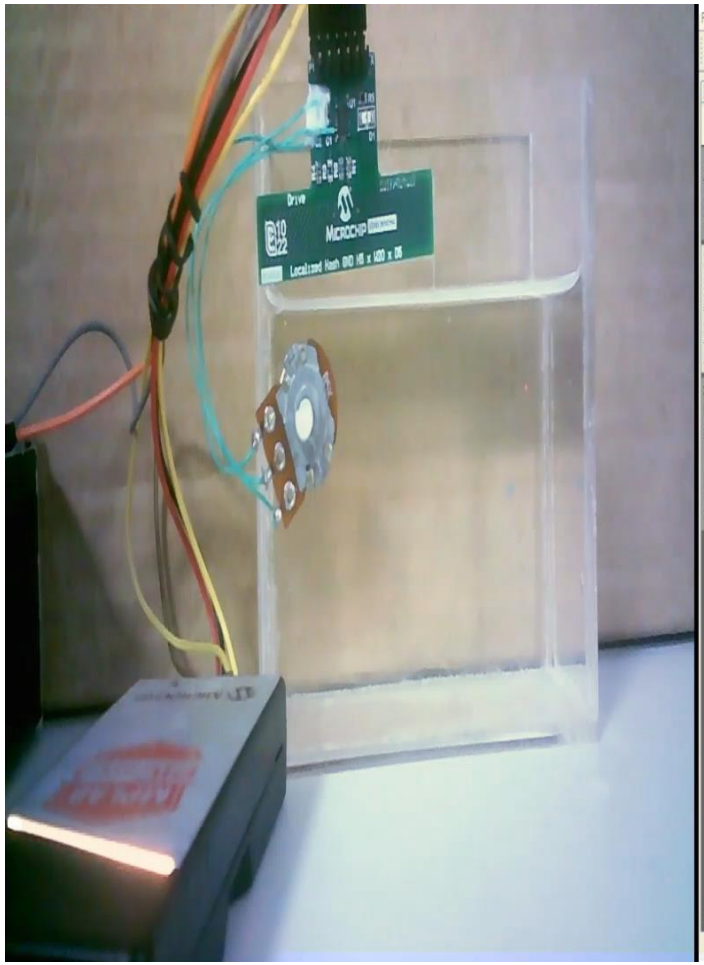
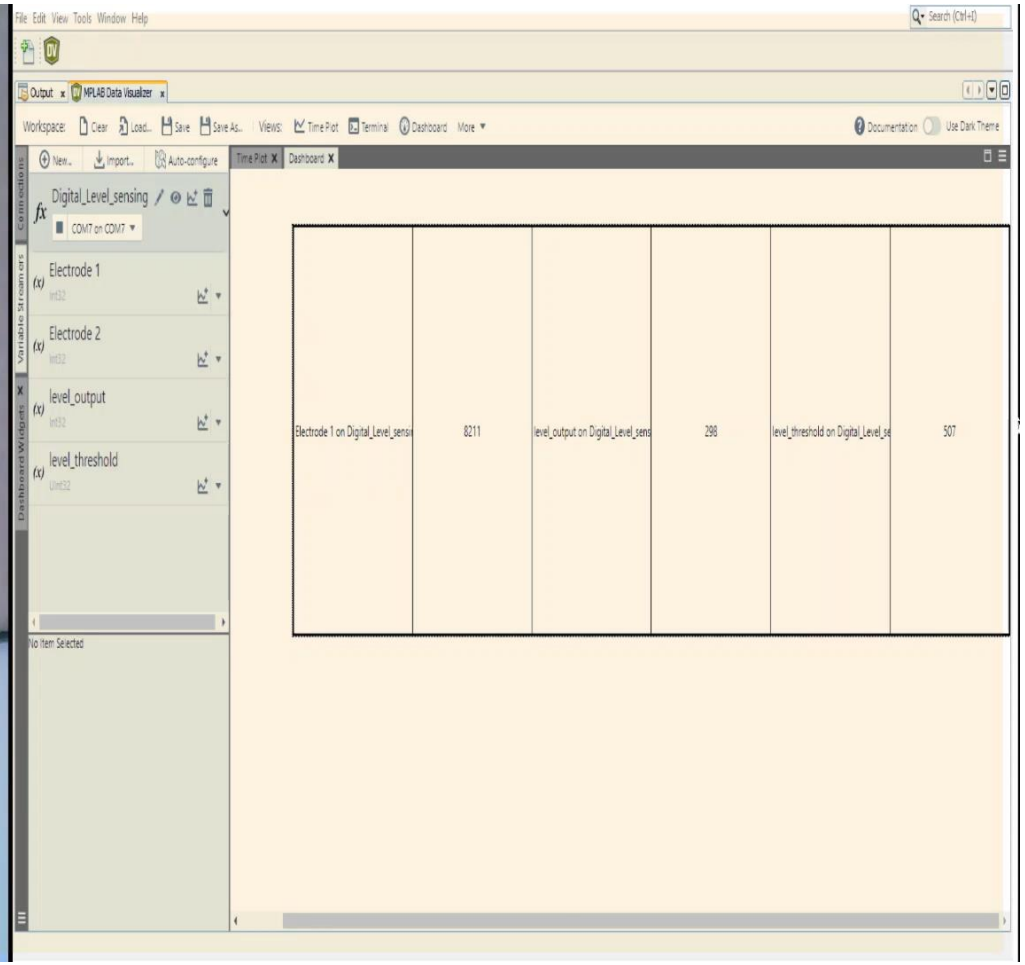
Ground Independent Measurement

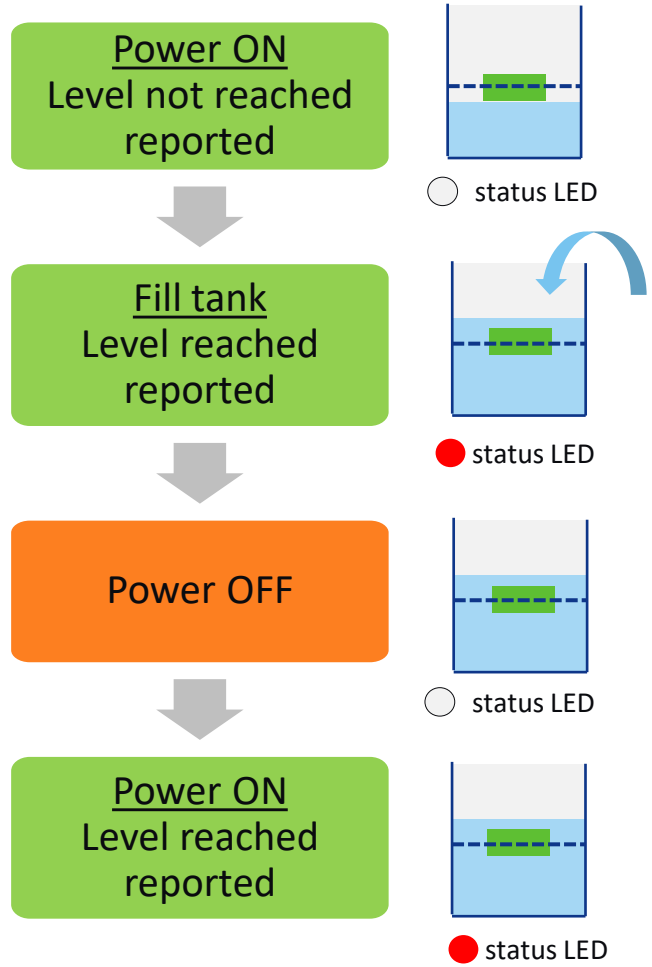


Consistent Level Reporting Through Power Cycles

No recalibration at each power-up – Always correct level report!







Digital Level Sensing Solution Package

Complete, validated, proven solution

- Noise tested up to 10V CI IEC61000-4-6
- Thermal tested
- Air gap characterized

The Library runs on DLS enabled MCUs (no additional Royalties or fees)

How to access the solution?

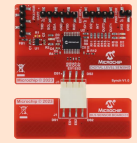
- Via Microchips Secure Document Extranet
- Under NDA
- Through your myMicrochip account

Level sensing library

Visualization tool

MPLAB® Data Visualizer GUI extension

Dev kit



Contact Microchip for access

Example projects

1 level and 2 levels

Documentation

- Library user guide
- Dev kit user guide
- Airgap characterization report

Schematics

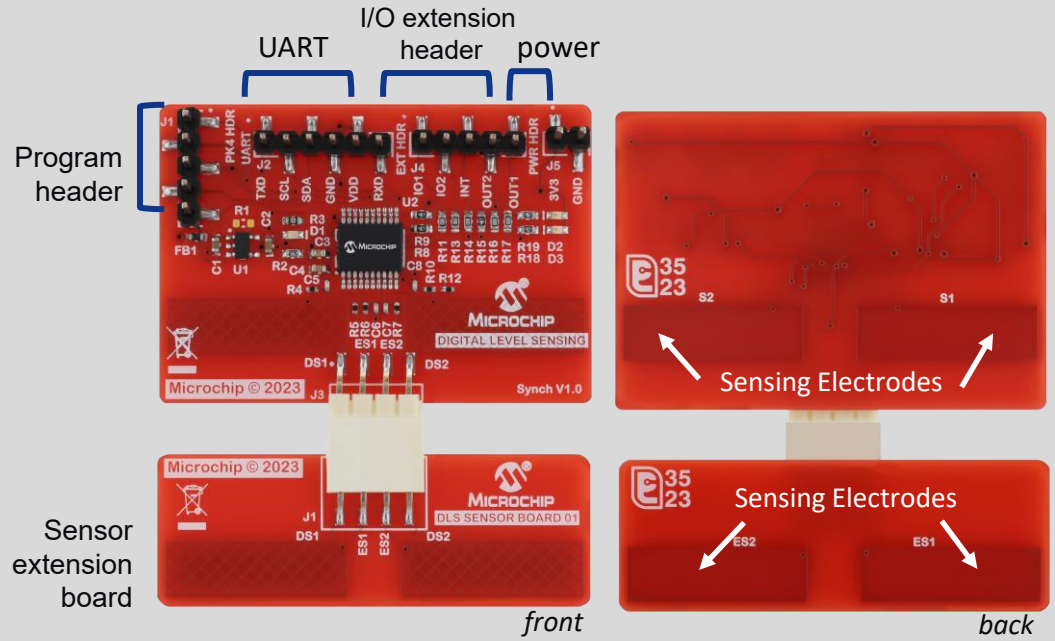
Dev Kit and Reference designs

Digital Level Sensing Solution Package

Evaluation Kit/Reference Board

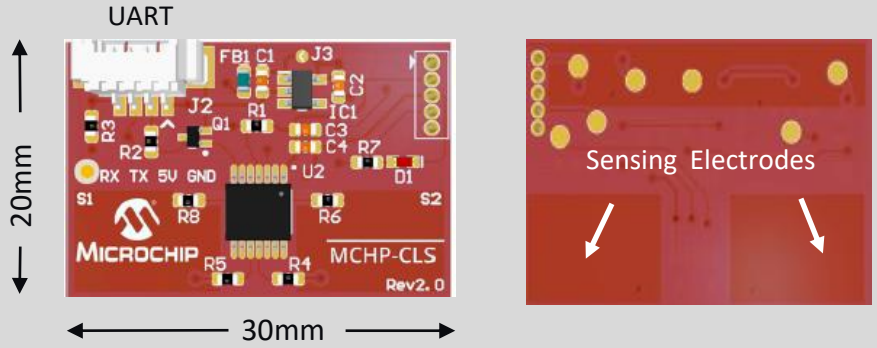
Evaluation Kit

- Evaluation platform for the DLS pre-release library
- PIC16LF1559-M10, level sensing enabled MCU
- Up to 2 levels, external sensor connection
- Visualization via MPLAB® Data Visualizer



Reference Implementation board

- PIC16LF1554-M10, level sensing enabled MCU
- 1 level
- Small form factor
- Schematics/layout a references in solution package



Digital Level Sensing Enabled MCUs

1 Digital level

- PIC16LF1554(T)-I/STM10 – TSSOP 14pins
- PIC16LF1554(T)-I/MLM10 – QFN 16pins

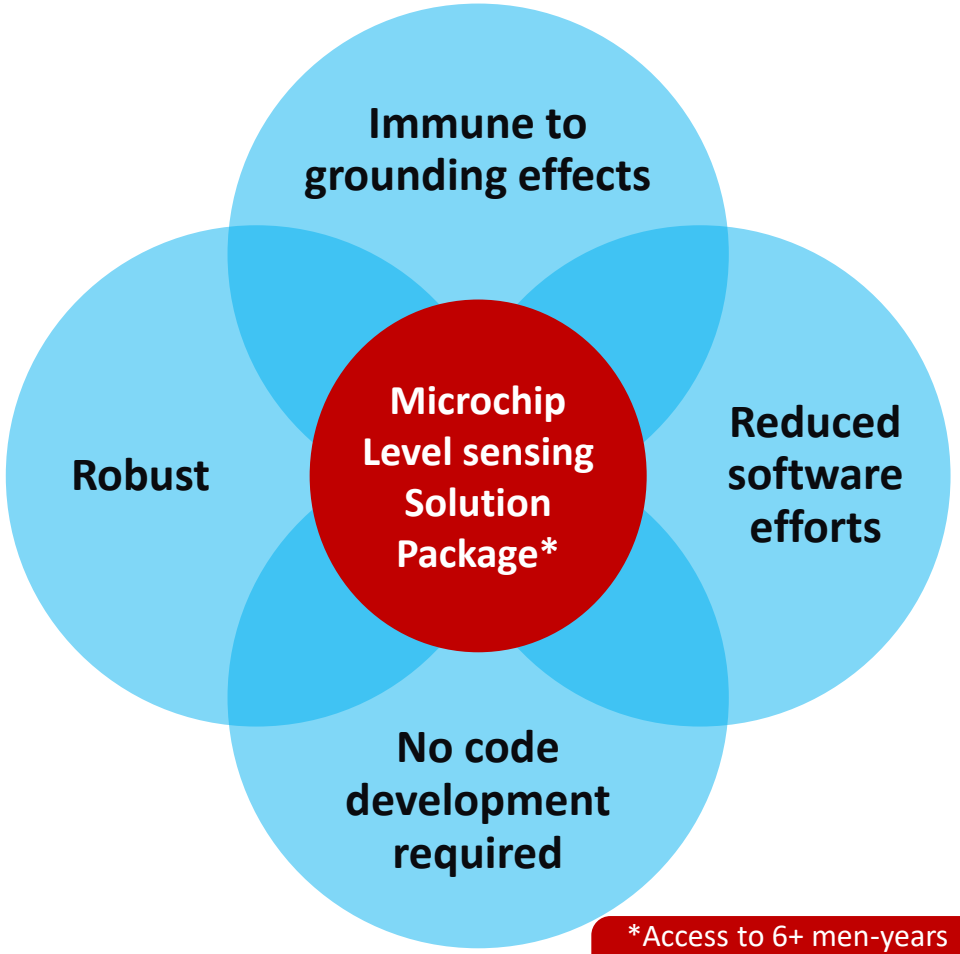
2 Digital levels

- PIC16LF1559(T)-I/SSM10 –SSOP 20pins
- PIC16LF1559(T)-I/MLM10 – QFN 20pins

Level Sensing CPN Ind. Temp +85°C	Level Sensing CPN Ext. Temp +125°C	Package	Level sensing Pkg Description
PIC16LF1554-I/STM10	PIC16LF1554-E/STM10	14 TSSOP 4.4mm TUBE	7KB Flash, 512B RAM, 12 I/Os,
PIC16LF1554T-I/STM10	PIC16LF1554T-E/STM10	14 TSSOP 4.4mm T/R	7KB Flash, 512B RAM, 12 I/Os,
PIC16LF1554-I/MLM10	PIC16LF1554-E/MLM10	16 QFN 4x4x0.9mm TUBE	7KB Flash, 512B RAM, 12 I/Os,
PIC16LF1554T-I/MLM10	PIC16LF1554T-E/MLM10	16 QFN 4x4x0.9mm T/R	7KB Flash, 512B RAM, 12 I/Os,
PIC16LF1559-I/SSM10	PIC16LF1559-E/SSM10	20 SSOP .209in TUBE	14KB Flash, 512B RAM, 18 I/Os,
PIC16LF1559T-I/SSM10	PIC16LF1559T-E/SSM10	20 SSOP .209in T/R	14KB Flash, 512B RAM, 18 I/Os,
PIC16LF1559-I/MLM10	PIC16LF1559-E/MLM10	20 QFN 4x4x0.9mm TUBE	14KB Flash, 512B RAM, 18 I/Os,
PIC16LF1559T-I/MLM10	PIC16LF1559T-E/MLM10	20 QFN 4x4x0.9mm T/R	14KB Flash, 512B RAM, 18 I/Os,

Microchip Capacitive Level Sensing

Unique value proposition



*Access to 6+ men-years of groundbreaking level sensing innovation

Fast to implement

- Complete solution out of the box
  - Evaluation kit, demo board, GUI for tune, schematics allow easy evaluation and prototyping
- No experience in capacitive touch is needed

Immune to grounding effects

- Level reporting is independent from grounding conditions:
  - Hands touching the container, finger touching the liquid …
- Increased accuracy, reliability

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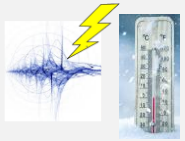
Robust

- Advanced noise immunity
- Stable across temperature drift
- Always correct at power up



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Microchip Capacitive Liquid Level Sensing

Example of application use cases

Homes appliance	Coffee machines, steam oven, washing machine	
Domestic care	Steam cleaner, humidifier, ironing	
Industrial	HVAC, food treatment, fluid levels	
Automotive	Washer fluid, coolant liquid, Water Level Sensing	

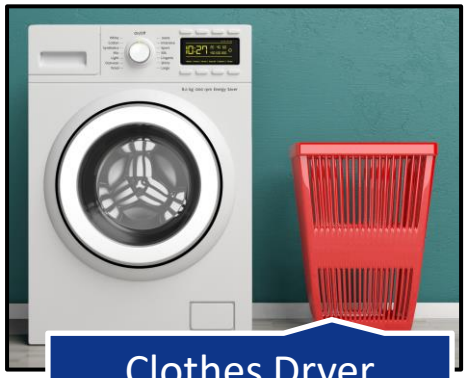
Home Appliance Level Sense Applications

Steam Ovens

Humidifier/
Dehumidifier

Vaccum Cleaner

Coffee Machines



Clothes Dryer
(water tray)

Steam Iron

Refrigerator
(ice level)

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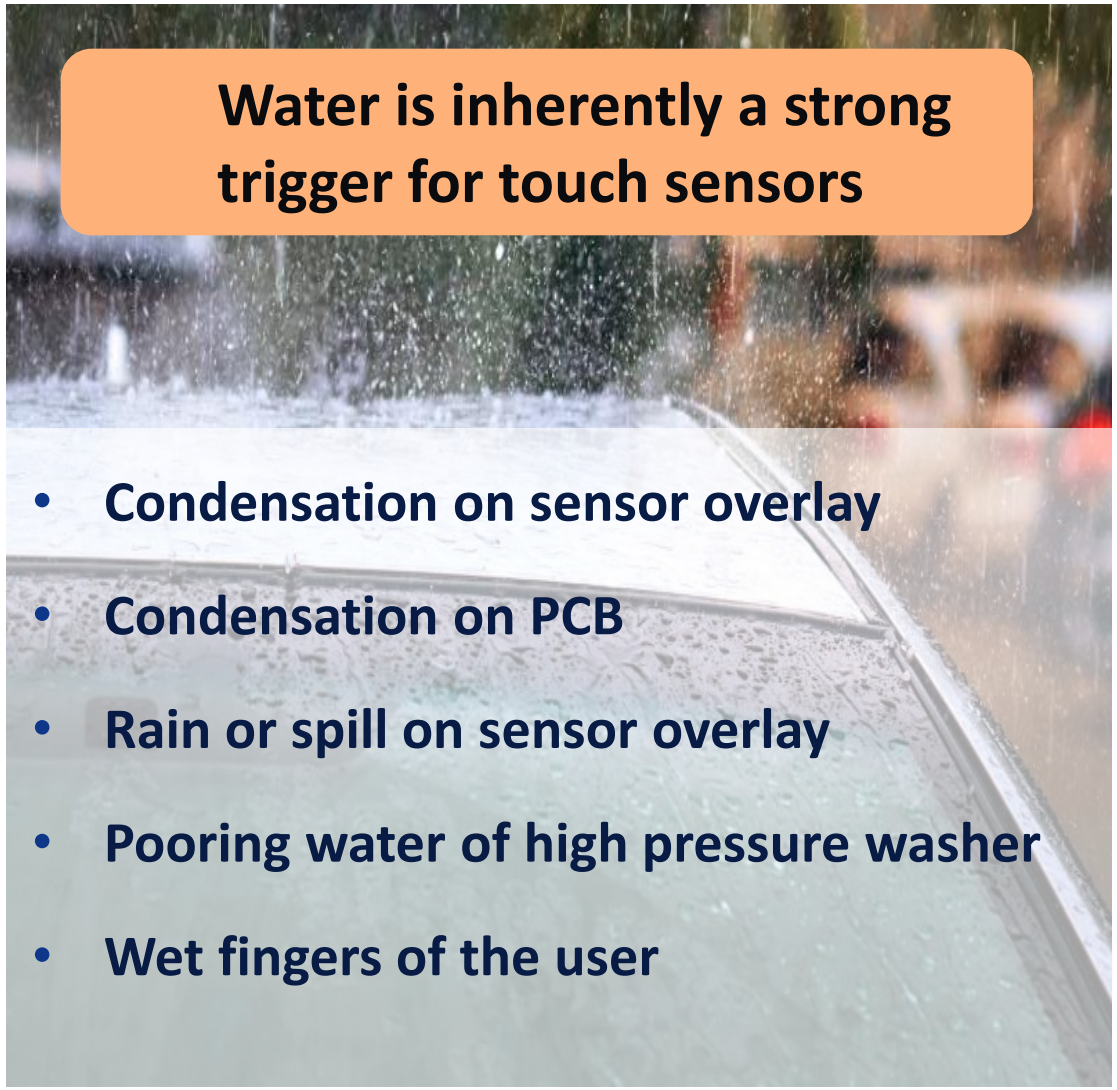
Impulse Touch Sensing(ITS) Solution

Challenges of Water Operation

Challenging operating conditions



Water is inherently a strong trigger for touch sensors

- Condensation on sensor overlay
- Condensation on PCB
- Rain or spill on sensor overlay
- Pooring water of high pressure washer
- Wet fingers of the user

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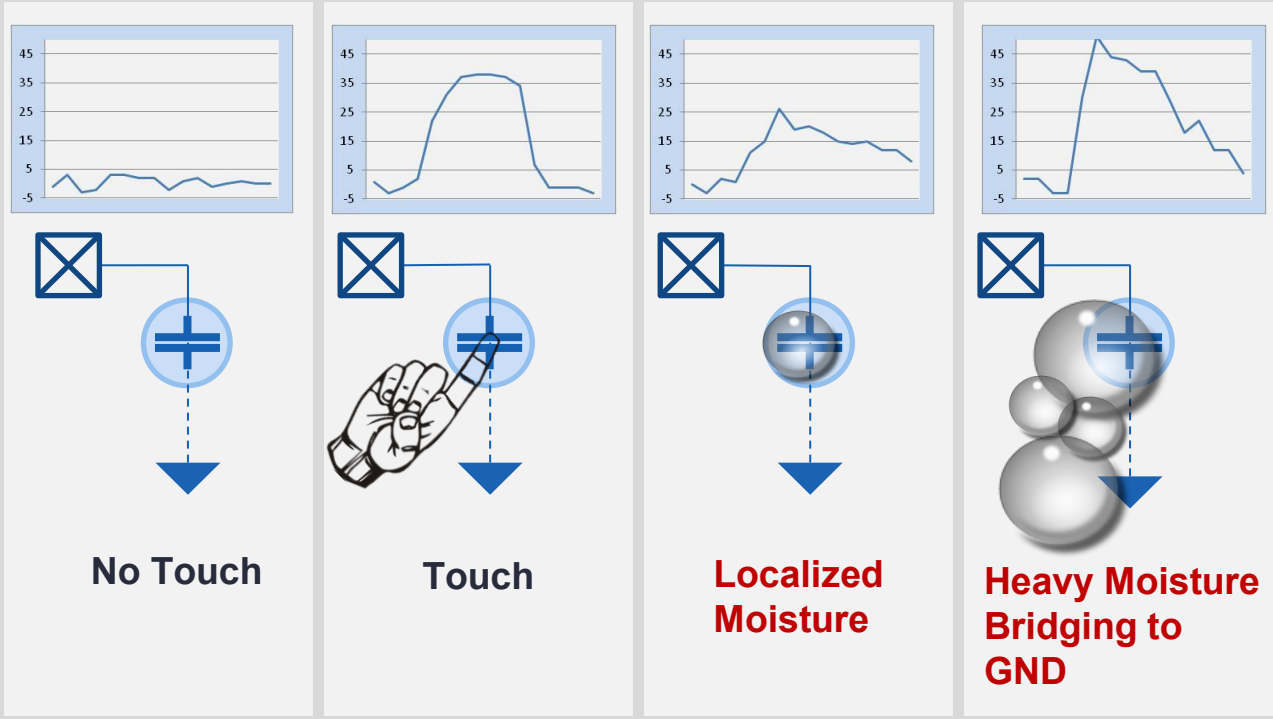
Microchip Masters Water Operation

Solved

Challenge:
Water is a short circuit to capacitive sensing



→ Water and water bridging to GND might cause false trigger

Solutions

- Driven Shield +
- ITS - Impulse Touch Sensing

ITS - solutions for Corner uses cases: rain / pressure washer

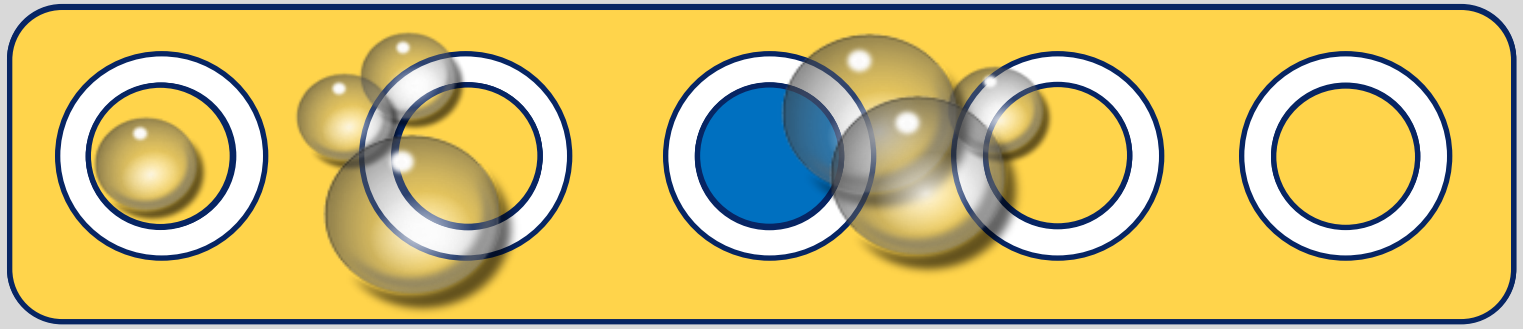
Water Tolerant Touch buttons

Driven Shield +

Driven Shield Evolution – Water Tolerance

Capacitive self-sensing

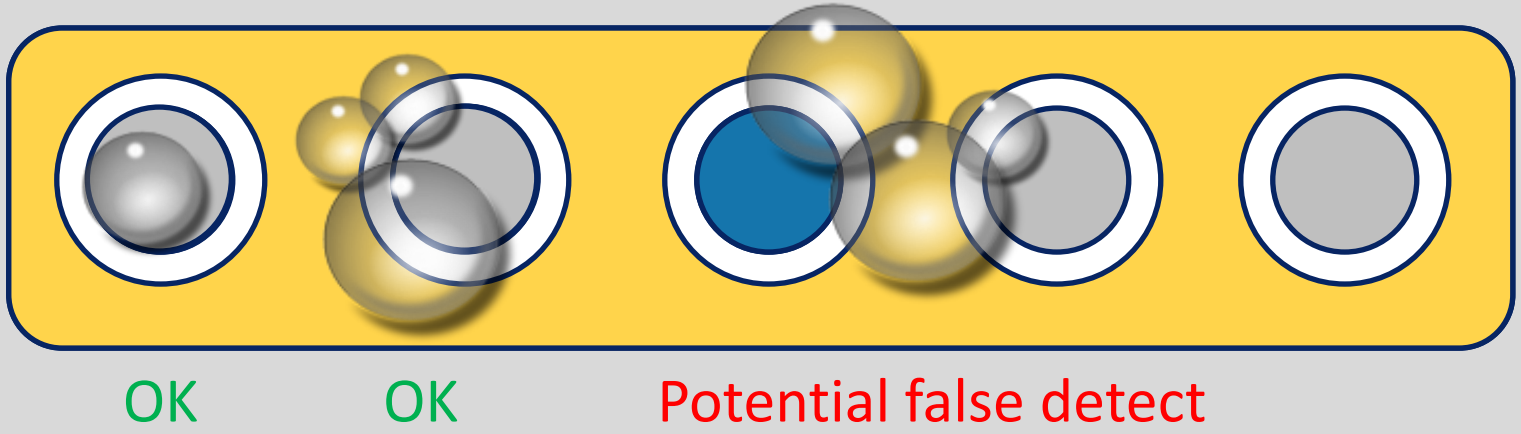
Water Tolerance



- **Driven Shield+**

  Everything driven with the same signal as the scanned electrode

Microchip's patented solution to achieve water tolerant touch.



- **Driven Shield**

  Guard ring and electrode scanned driven at same potential

Water Tolerance

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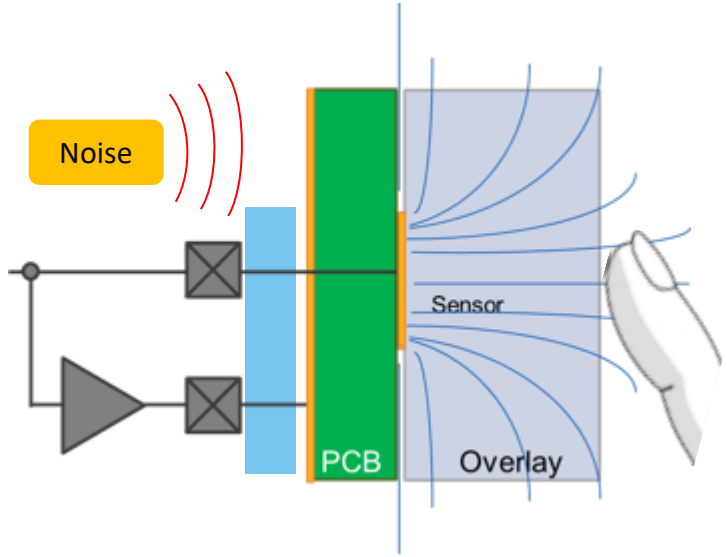
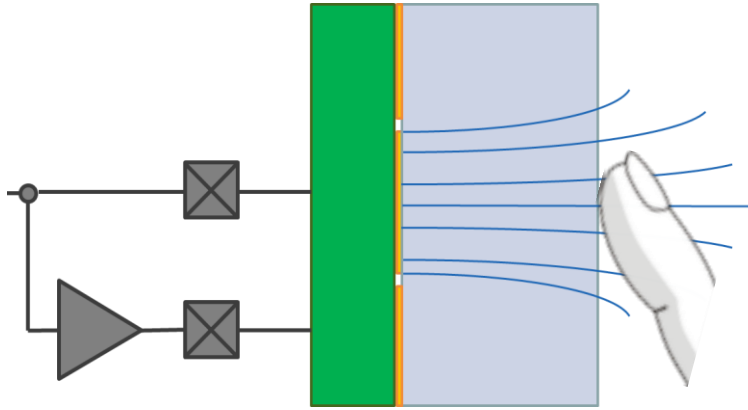
Driven Shield+ for Self-Capacitance

- **Advantages**
  - Ensures maximum shielding with no loss of sensitivity
  - Boosts sensitivity and thereby signal-to-noise ratio (SNR)
- **How**
  - A shield driven with the same signal as the sensor



Bi-Planar Shield

- Provides excellent shielding from system noise or ground loads without loss of sensitivity



Co-Planar Shield

- Creates a lens effect that provides a ~2x sensitivity increase.

Impulse Touch Sensing (ITS)

For uses cases with extreme water requirements

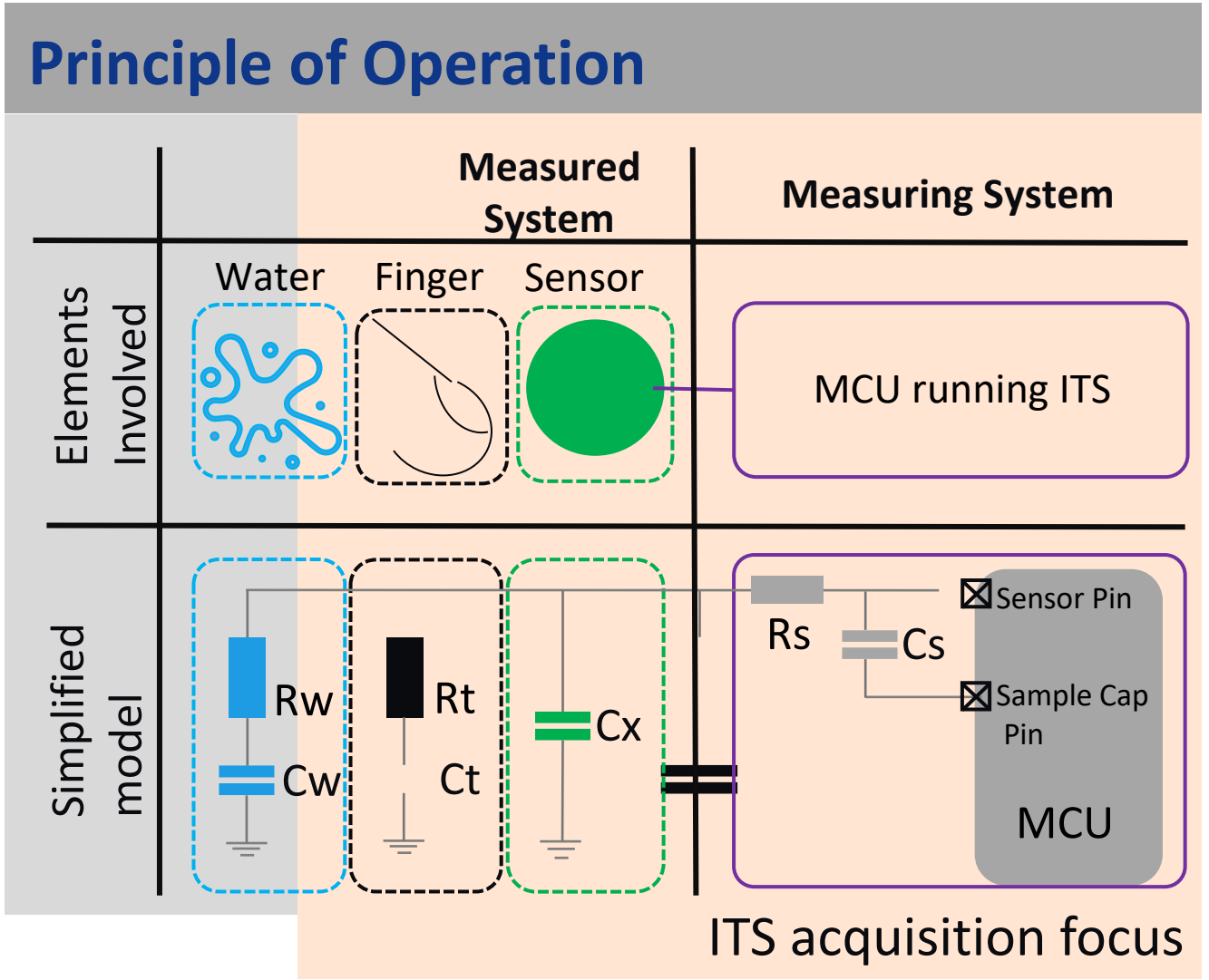
- **A dedicated touch solution for robust touch detection under severe water conditions**
  - igh pressure water, pooling water, …
- **Use case examples**
  - Car door handle (Open/close buttons)
  - Single button outside cars, scooters, motorbikes
    - EV charge door flap,
    - Door control
    - EV scooter Battery control
- **Other usages with severe water conditions applies**
  - Not limited to automotive

Door handle, EV charging flap - heavy water conditions

ITS – Basic of Operations

System description

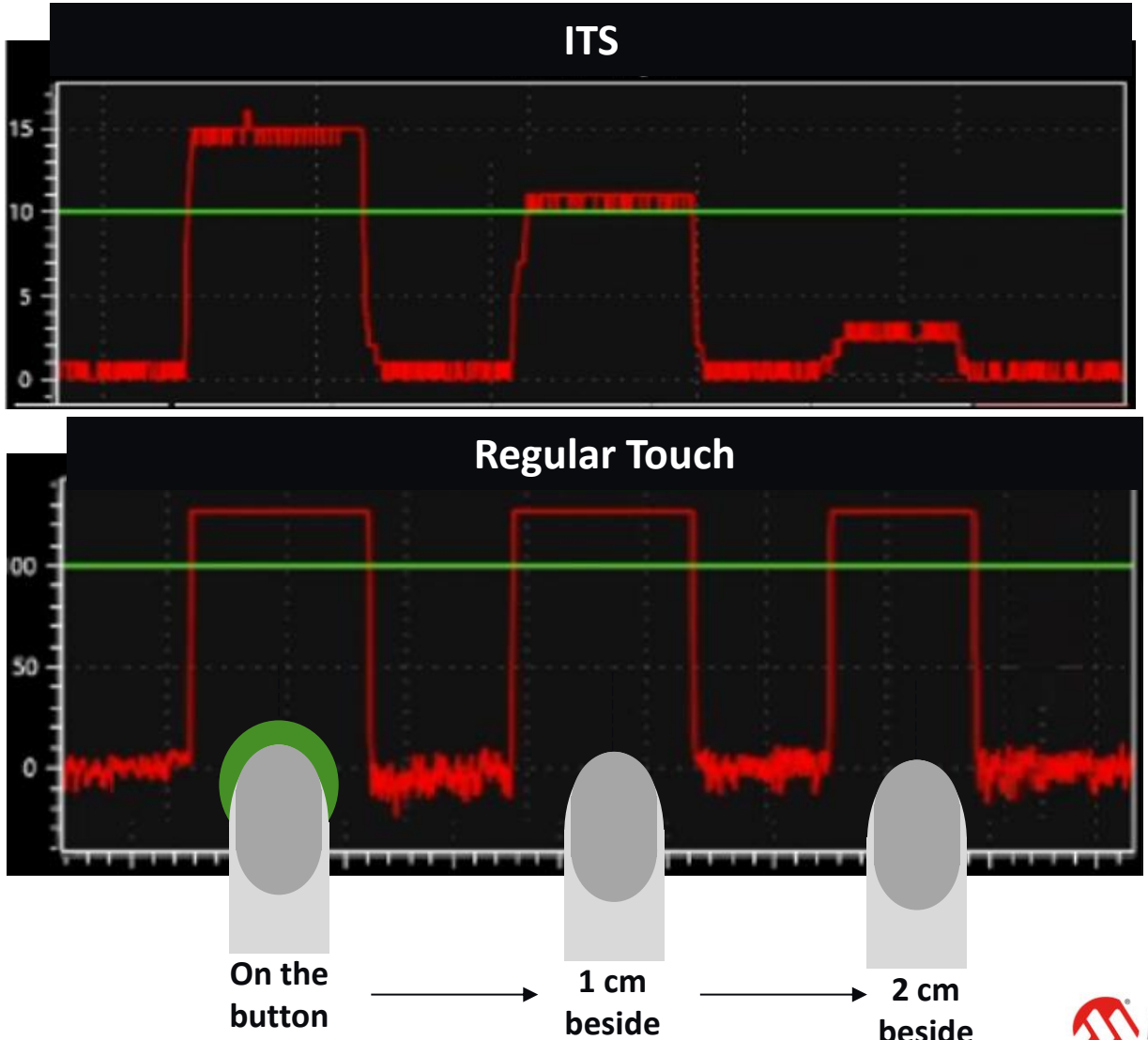
- **ITS removes the impact of water** on touch signal **at time of signal acquisition**
- Charge the sensor and not the surrounding water



ITS Reduces the Impact of Water with Distance

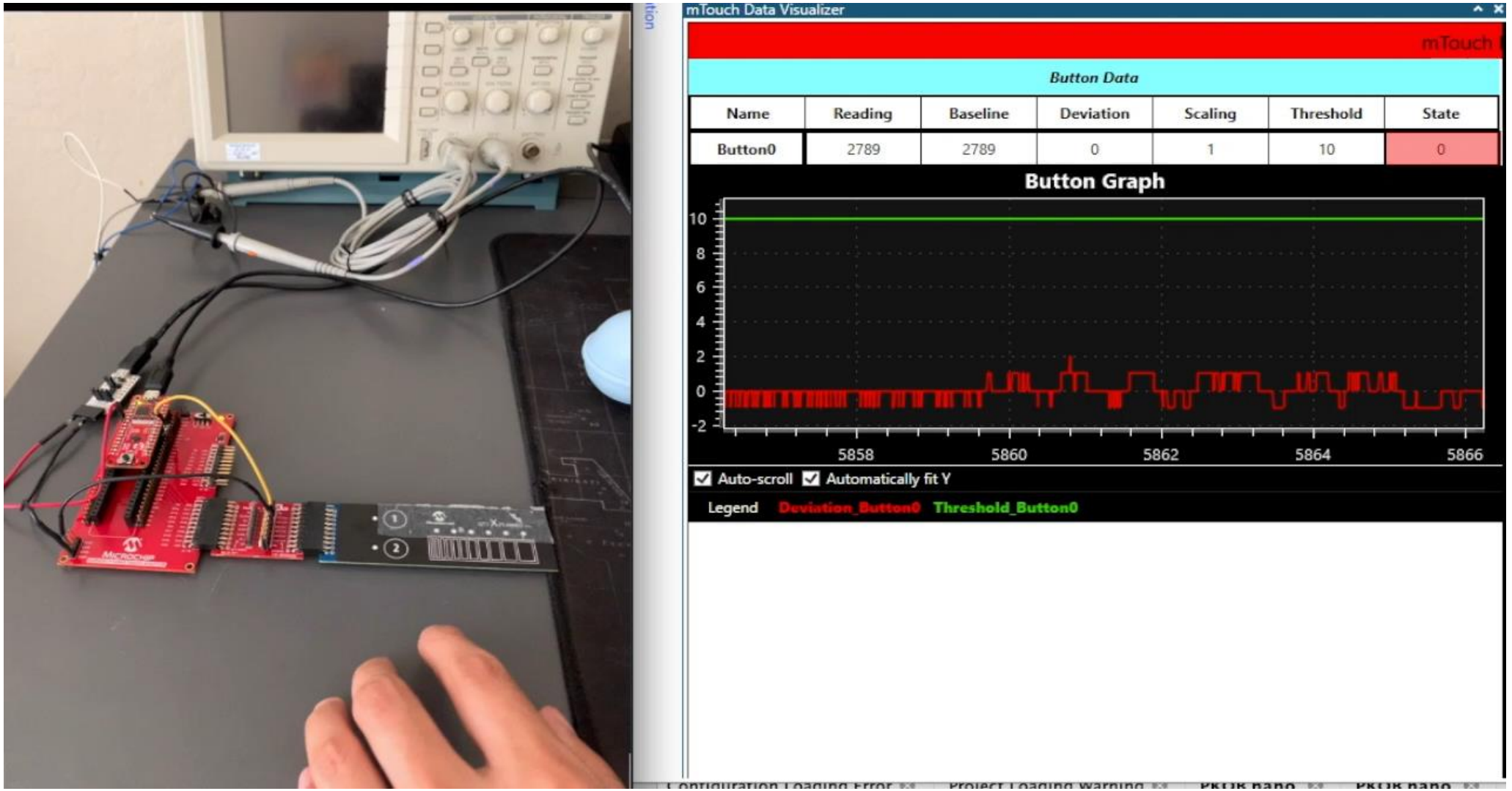
ITS versus regular touch when distance increase

- ITS significantly **reduces** the **impact of water** when the finger touches **besides the button**
- Increasing accuracy and reliability of touch detection



ITS Reduces the Impact of Water with Distance

ITS versus regular touch when distance increase



How to access ITS solution?

ITS library and Microchip MCUs

Concept

- **ITS library running on Microchip MCUs**
  - ITS library access under NDA through Microchip's Secure Document Extranet

I buy a Microchip MCU – that's it?

- **Yes**
- No any other fees or royalties.

ITS is intended for use cases with the highest requirements on water tolerance
Pressure washer, pooling water are exemplary key use case aspects

ITS library supported MCUs

The list of ITS enabled MCUs evolves with customer requirements – below are examples

- **Library for 8-bit MCUs**
  - Up to 4 ITS buttons
  - PIC16F152/184
  - PIC18FQ40/Q84 with CAN-FD
- **Library for 32-bit MCUs**
  - Up to 10 ITS buttons
  - adding Core independent acquisition
  - SAMC21 with CAN-FD
- **Documentation**
  - Firmware API guide
  - Tuning Guide

Thank You